

SERIES **8000**

Modular rack-mounted  
multichannel  
position sensing



FEATURES

- A modularized rack format for customized, building-block solutions.
- Standard 3U by 7T Eurocard modules.
- Resolution to 10 microinches or better.
- Multiple channels, rack mounted or bench-top enclosures.
- Choice of 16 standard sensors.
- Add-on function modules provide summation/comparison, dual set points, voltage-to-current conversion, and dynamic measurements.
- Dual-channel NEMA enclosure available.

**THE SERIES 8000 HIGH-PRECISION MODULAR MEASURING SYSTEM**

The Series 8000 high-precision displacement measuring system comes in a modularized rack format to provide customized building-block measuring solutions.

The Series 8000 rack houses standard 3U by 7T Eurocard modules and encases an included power supply that is switchable from 120 to 240 VAC, 50 to 60 Hz. It also encases an optional 21T integral display and the fundamental KDM-8200 measurement module. Each KDM-8200 measurement module creates a separate measuring channel.

**Series 8000 building-blocks**

Additional function modules can fit into the Series 8000 rack to perform special functions on the KDM-8200 measurements. These function modules can include combinations of:

- SC-8000 summation/comparator
- DSP-8000 dual set point
- VC-8000 voltage-to-current converter
- DY-8000 dynamic measurement.

The Series 8000 comes in four enclosures:

**3U/84HP 19-inch rack** (12.7 inches/323 mm deep) encloses up to 12 channels.

**3U/63HP mid-rack** (12.28 inches/312 mm deep) is a Eurocard instrument case with a handle and nine-channel capacity.

**3U/42HP half-rack instrument case** (12.28 inches/312 mm deep) has handle and six channel capacity.

**NEMA 12 enclosure** holds two channels, one function card, integral display, and power supply. 8.14"W x 8.18"L x 4.64"H (208 x 209 x 118 mm).



▲ 3U/42HP bench-top half rack



▲ Series 8000 NEMA enclosure



◀ 3U/84HP 19-inch rack

# KDM-8200

## SERIES 8000 MEASUREMENT MODULE

The KDM-8200 is the fundamental measurement module of the Series 8000 noncontact measurement system. Like all Series 8000 modules, the KDM-8200 is a 3U by 7T Eurocard module. The KDM-8200 measurement module contains the inductive bridge and signal conditioning circuits that produce the measurement output. This output is a linear voltage proportional to the physical displacement of the target relative to the sensor.

The KDM-8200 is used with the Series 8000 sensors shown on pages 4 and 5.

### Specifications

**Technology:** Inductive bridge.

**Sensors:** 14 standard (see specifications).

**Electrical input:**

*Voltage:*  $\pm 15$  Vdc.

*Current:*  $< 50$  mA / side.

*Regulation:*  $\pm 0.5$  Vdc.

**Signal out:** User adjustable depending on sensor selection;  $\pm 5$  V maximum.

**Operating temperature:**

*Sensor and cable:*  $-67^{\circ}\text{F}$  to  $+220^{\circ}\text{F}$   
( $-55^{\circ}\text{C}$  to  $+104^{\circ}\text{C}$ ).

*Electronics:*  $+32^{\circ}\text{F}$  to  $+122^{\circ}\text{F}$  ( $0^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ ).

**Storage temperature:**

*Sensor and cable:*  $-67^{\circ}\text{F}$  to  $+220^{\circ}\text{F}$   
( $-55^{\circ}\text{C}$  to  $+104^{\circ}\text{C}$ ).

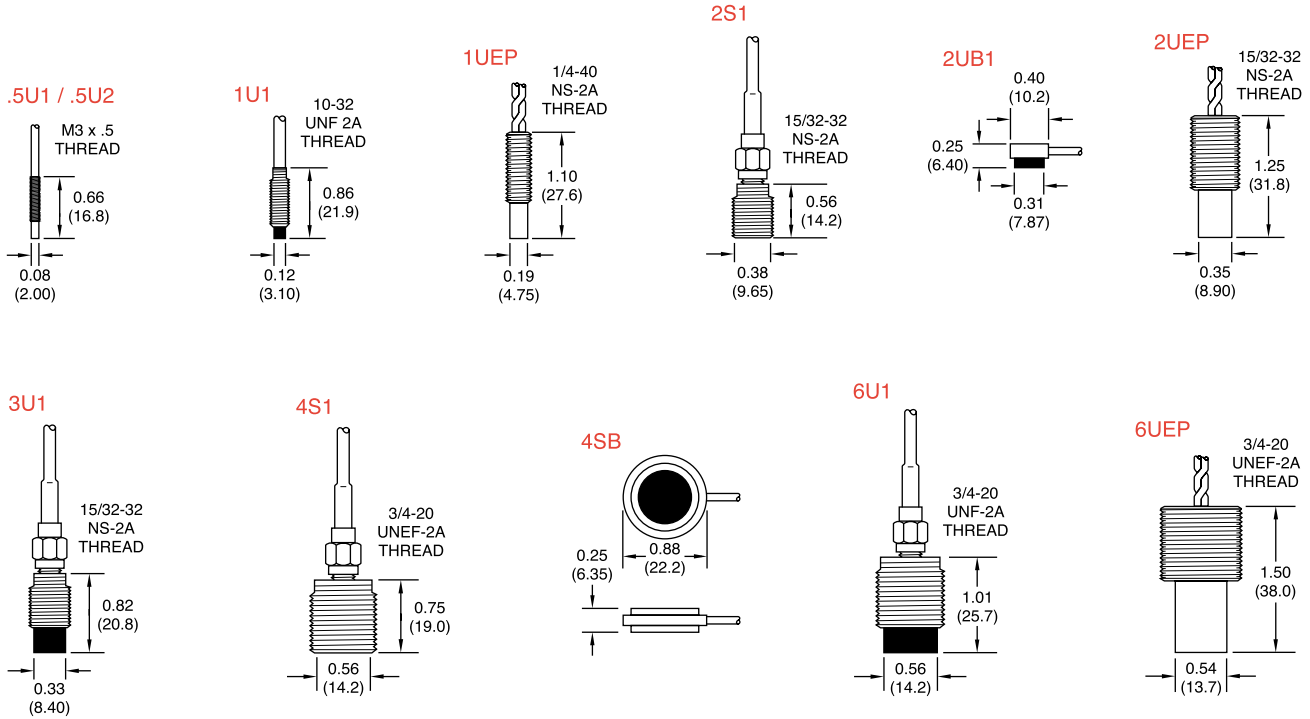
*Electronics:*  $-13^{\circ}\text{F}$  to  $+185^{\circ}\text{F}$  ( $-25^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ).

**Size:** One 7T slot wide.



▲ KDM-8200 position measurement module

## SERIES 8000 SENSORS



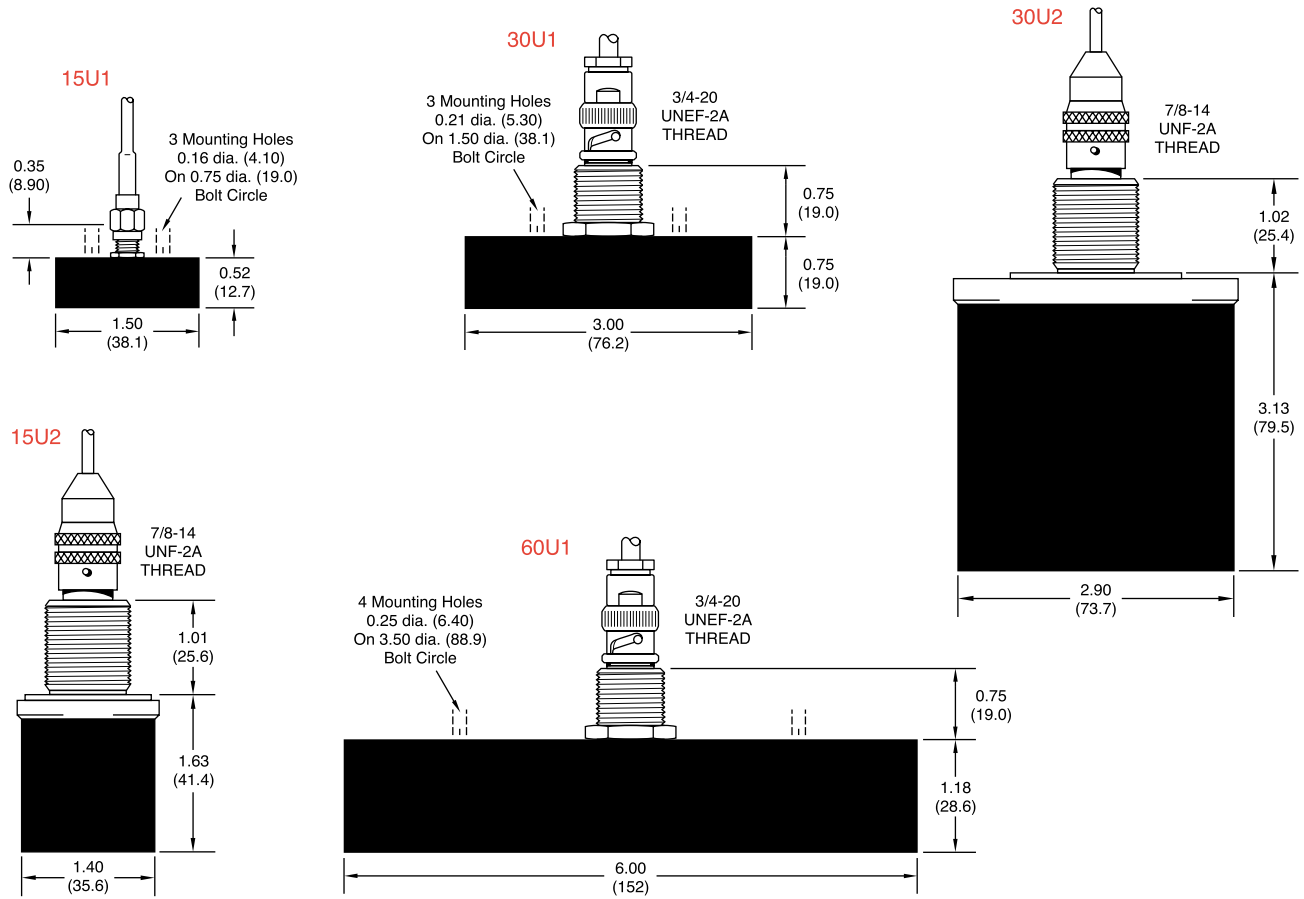
**Sensors shown at 50%** *Note: All dimensions shown in inches (mm).*

Sensor Type		.5U1	.5U2	1U1	1UEP	2UB1	2S1	2UEP	3U1	4S1
<b>Target Material</b>	non-ferrous ferrous	Yes No	No Yes	Yes No	* Yes	Yes *	Yes *	* Yes	Yes *	Yes Yes
<b>Measuring range</b>	mil mm	20 0.5		40 1	40 1	80 2	80 2	80 2	120 3	160 4
<b>Offset</b>	mil mm	2 0.05		0.006 0.13	0.006 0.13	0.015 0.38	0.015 0.38	0.025 0.63	0.020 0.51	0.020 0.51
<b>Resolution (<math>\leq</math>mid range)</b>	mil mm	0.004 0.0001		0.004 0.0001	0.004 0.0001	0.008 0.0002	0.008 0.0002	0.008 0.0002	0.012 0.0003	0.016 0.0004
<b>Nonlinearity</b> ( $\pm 0.5\%$ of measuring range)	$\pm$ mil $\pm$ mm	0.1 0.003		0.2 0.005	0.2 0.005	0.4 0.01	0.4 0.01	0.4 0.01	0.6 0.015	0.8 0.02
<b>Factory sensitivity**</b>	mV/mil	100		10	10	10	10	10	10	10
<b>Operating temperature</b> Sensor and cable	$^{\circ}$ F	-67 $^{\circ}$ to +220 $^{\circ}$		-67 $^{\circ}$ to +220 $^{\circ}$	-452 $^{\circ}$ to +400 $^{\circ}$	-67 $^{\circ}$ to +220 $^{\circ}$	-67 $^{\circ}$ to +220 $^{\circ}$	-452 $^{\circ}$ to +400 $^{\circ}$	-67 $^{\circ}$ to +220 $^{\circ}$	-67 $^{\circ}$ to +220 $^{\circ}$
<b>Frequency response</b>		Static to 50 kHz (-3dB pt.)								
<b>Thermal sensitivity shift</b>		0.1% FSO/ $^{\circ}$ F without temp. comp.; 0.02% FSO/ $^{\circ}$ F with temp. comp.								

\*Must specify actual target material. Performance specification may change.

\*\*Sensitivities are user-adjustable from 1 mV/mil to 100 mV/mil, unipolar or bipolar output, application dependent.

**SERIES 8000 SENSORS**



**Sensors shown at 50%** *Note: All dimensions shown in inches (mm).*

Sensor Type		4SB	6UEP	6U1	15U2	15U1	30U2	30U1	60U1
Target Material	non-ferrous ferrous	Yes *	Yes Yes	Yes *	Yes Yes	Yes *	Yes Yes	Yes Yes	Yes Yes
Measuring range	mil mm	160 4	240 6	240 6	600 15	600 15	1200 30	1200 30	2400 60
Offset	mil mm	0.030 0.75	0.035 0.89	0.035 0.89	0.150 3.81	0.150 3.81	0.3 7.5	0.3 7.5	0.6 15
Resolution ( $\leq$ mid range)	mil mm	0.016 0.0004	0.024 0.0006	0.024 0.0006	0.060 0.0015	0.060 0.0015	0.120 0.003	0.120 0.003	0.240 0.006
Nonlinearity ( $\pm$ 0.5% of measuring range)	$\pm$ mil $\pm$ mm	0.8 0.02	1.2 0.03	1.2 0.03	3.0 0.075	3.0 0.075	6.0 0.15	6.0 0.15	12.0 0.30
Factory sensitivity**	mV/mil	10	10	10	1	1	1	1	1
Operating temperature Sensor and cable	$^{\circ}$ F	-67 $^{\circ}$ to +220 $^{\circ}$	-452 $^{\circ}$ to +400 $^{\circ}$	-67 $^{\circ}$ to +220 $^{\circ}$	-67 $^{\circ}$ to +220 $^{\circ}$	-67 $^{\circ}$ to +220 $^{\circ}$	-67 $^{\circ}$ to +220 $^{\circ}$	-67 $^{\circ}$ to +220 $^{\circ}$	-67 $^{\circ}$ to +220 $^{\circ}$
Frequency response	Static to 50 kHz (-3dB pt.)								
Thermal sensitivity shift	0.1% FSO/ $^{\circ}$ F without temp. comp.; 0.02% FSO/ $^{\circ}$ F with temp. comp.								

\*Must specify actual target material. Performance specification may change.

\*\*Sensitivities are user-adjustable from 1 mV/mil to 100 mV/mil, unipolar or bipolar output, application dependent.

# SC-8000

## SERIES 8000 SUMMATION/ COMPARATOR FUNCTION MODULE

The summation/comparator module has HI/LO limit comparators with latched opto-isolated or open collector outputs. It sums the analog displacement of two channels to provide one of three kinds of information.

### 1. Alignment or centering (A-B)

The A-B function is used to sense alignment by centering the target(s) between two sensors. A centered target produces an output of zero. A deviation of position produces a positive or negative output into engineering units of displacement.

### 2. Outside diameter (OD) or thickness, C-(A+B)

The value C represents the separation of two sensors and is constant. The values A and B are the distances from sensors A and B to the target. Two types of OD/thickness measurements are possible with the C-(A+B) function:

- absolute or total thickness of target;
- deviation from a nominal thickness.

### 3. Inside diameter (ID), C+(A+B)

As in the case of the OD measurement, C is the separation of the two sensors, and A and B are the distances from the two sensors to the target. The C+(A+B) function provides absolute ID, or deviation from a nominal ID.



▲ SC-8000 summation/comparator module

## Specifications

**Channels:** Single or dual.

**Electrical input:**

*Voltage:*  $\pm 15$  Vdc.

*Current:*  $< 50$  mA each side.

*Regulation:*  $\pm 0.5$  Vdc.

**Size:** One 7T slot wide.

**Frequency response:** Flat to 30 kHz.

**Phase response:**  $0^\circ$  from 0 to 30 kHz.

**Offset:** Adjustable to zero.

**Gain (for each channel):** Unity gain  $\pm 1\%$ .

**Offset drift with temperature:**  $0.5$  mV/ $^\circ$ C.

**Dynamic range:** 90 dB.

**Analog math functions:**  $\pm K[C \pm (A \pm B)]/N$ .

**Standard function:** C-(A+B) driving comparator.

**Optional functions:** One channel comparator only;  
math function only.

**Temperature:**

*Operating:*  $+32^\circ$ F to  $+122^\circ$ F ( $0^\circ$ C to  $+50^\circ$ C).

*Storage:*  $-13^\circ$ F to  $+185^\circ$ F ( $-25^\circ$ C to  $+85^\circ$ C).

# DY-8000

## SERIES 8000 DYNAMIC MODULE

The DY-8000 dynamic module converts dynamic time-varying signals to stable DC values. This function is necessary when the target is vibrating or rotating in applications such as shaft runout, bearing noise, ultrasonic weldhorn amplitude, acoustic noise, solenoid switching, etc.

The multi-function capabilities of this module allow dual-channels or combinations of the following conversions:

- 1. Positive peak conversions.** The positive peak function produces an output voltage equal to the maximum amplitude of an analog input voltage. This conversion provides the amplitude of a vibrating target.
- 2. Negative peak conversions.** The negative peak function produces an output voltage equal to the minimum amplitude of an analog input voltage. The lowest value could be the least positive or most negative input voltage.
- 3. Peak-to-peak conversions.** The peak-to-peak function produces an output voltage equal to the difference between the highest and lowest analog input signals. This conversion provides total indicated runout (TIR).
- 4. RMS-to-DC conversions.** This function computes the true RMS level of an AC sinusoid with DC offset, square wave, and Gaussian noise input, and converts this RMS value to a DC output voltage.



▲ *DY-8000 dynamic module*

## Specifications

**Channels:** Single or dual depending on selected output options.

**Comparator hysteresis:** 25 to 50 mV.

**Adjustment range:** 0 to 7 volts.

**Bandwidth (-3 db point):** >50 kHz (input dependent; contact factory).

**Operating temperature:** +32°F to +122°F (0°C to +50 °C).

**Input power:**

*Positive current:* 80 mA.

*Negative current:* 30 mA.

**Size:** One 7T slot wide.

# DSP-8000

## SERIES 8000 DUAL SET POINT FUNCTION MODULE

The dual set point function module allows the user to set voltage levels as HI and LO references. This card compares an input voltage from one or two sources to these references, and triggers three output responses based on this comparison.

When a HI or LO indicator is illuminated on the front panel, the HI or LO open collector output conducts current. External user-provided circuitry can convert this current into a voltage or digital logic. The GO state is the logic NOR of the LO and HI. This GO relay can be configured to be either ON or OFF while energized and opposite while de-energized. The DSP-8000 has two independent channels, each with HI and LO set points.

The most common application for the DSP-8000 module is a window comparator. When the input voltage of a window comparator is below the LO set point, the LO indicator will illuminate. When the input rises above the LO set point, the LO state turns off, and the GO indicator illuminates. As the input continues to rise above the HI set point, the GO state turns off and the HI indicator illuminates. The GO state can indicate in tolerance; the LO and HI states can indicate out of tolerance.

The DSP-8000 can provide progressive comparison indicating GO, ALARM, or SHUT DOWN. The module also features a part present/set point inhibit. This feature inhibits the HI, LO, and GO outputs.



▲ DSP-8000 dual set point function module

## Specifications

**Channels:** Single or dual.

**Size:** One 7T slot wide.

**Output:** Open collector transistors (2N2270) on HI and LO states (opto-isolated output transistors are available); relay on GO state, configurable as normally open or closed.

**Relay current:** 2 A at 24 Vdc.

**Open collector current:** 150 mA.

**Comparator hysteresis:** 10 to 30 mV depending on configuration and adjustment setting.

**HI/LO transistor on time:** <100  $\mu$ sec.

**HI/LO transistor off time:** <800  $\mu$ sec.

**Relay on/off time:** <4 milliseconds nominal.

**Adjustable resolution:**  $\pm 2$  mV.

**Adjustment range:** -3.8 to +6.8 V standard.

## Application Information Form

Fax this form to us for a quote at fax number 860-632-4515.  
Or call us at 860-632-4573.

Your name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_

Telephone \_\_\_\_\_ Fax \_\_\_\_\_

### Target Material

Type \_\_\_\_\_  
(Aluminum, 303 SS, brass, 4130 steel, etc.)

Size \_\_\_\_\_  
(Diameter, length x width)

Thickness \_\_\_\_\_

Geometry \_\_\_\_\_  
(Flat, shaft, sphere, etc.)

Nature of movement \_\_\_\_\_  
(e.g. Perpendicular to sensor axis, across/parallel to sensor face, rotation, etc.)

Speed \_\_\_\_\_  
(e.g. RPM, vibration frequency, feet per min./sec., etc.)

### Thermal Environment

Temperature range @ sensor \_\_\_\_\_

Temperature range @ electronics \_\_\_\_\_

### Performance Requirements

Total measuring range \_\_\_\_\_ to \_\_\_\_\_

% Nonlinearity \_\_\_\_\_ %FSO

Temperature coefficient \_\_\_\_\_ %FS/°C

Resolution \_\_\_\_\_

Analog output \_\_\_\_\_  
(e.g. 0-5 Vdc, -2.5 to +2.5 Vdc over range of target movement)

Packaging \_\_\_\_\_  
(NEMA 4, half rack, 3/4 rack, full rack)

### Other Factors

Contaminants in proximity to sensor \_\_\_\_\_

Potential EMI/RFI sources \_\_\_\_\_

### Expected Hardware Requirement

Prototype Units:                      Production Units:

Quantity \_\_\_\_\_ Quantity \_\_\_\_\_

Date required \_\_\_\_\_ Date required \_\_\_\_\_

Diagram

*Although we provide assistance on Kaman products both personally and through our literature, it is still the total responsibility of the customers to determine the suitability of any product in their application.*

# VC-8000

## SERIES 8000 VOLTAGE-TO-CURRENT CONVERTER MODULE

The VC-8000 converter module fits into the Series 8000 Eurocard rack, but can also be designed into custom measurement systems. The VC-8000 will provide an isolated output current loop.

### Specifications

**Channels:** Single or dual.

**Electrical input:**

*Voltage:*  $\pm 15$  Vdc.

*Current:* 35 mA each side.

**Signal in:** 0 to 5 V standard; 0 to 10 and 0 to X volts optional.

**Signal out:** 4 to 20 mA standard; 0 to 20 mA optional.

**Non-linearity:** Tracks with input to  $\pm 0.05$ .

**Input impedance:** 25 k $\Omega$  (0 to 5 V range).

**Common mode rejection @ 60 Hz:** 90 dB.

**Bandwidth:** 400 Hz (small signal).

**Drive capability:** 0 to 100  $\Omega$  load.

**Temperature:**

*Operating:* +32°F to +122°F (0°C to +50°C).

*Storage:* -13°F to +185°F (-25°C to +85°C).

**Size:** One 7T slot wide.



▲ VC-8000 voltage-to-current converter module

## ORDERING INFORMATION

Before ordering, you will need to determine which sensor model fits your application. You will also need to consider sensor cable length. Please call Kaman's applications engineering, and we will be glad to assist you with these decisions.